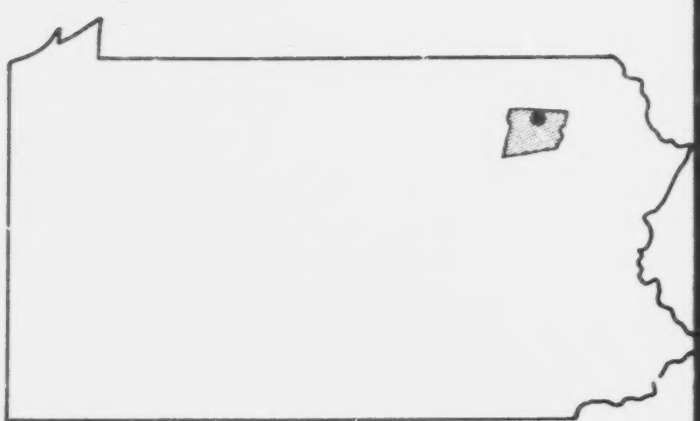
FLOOD INSURANCE STUDY

TOWNSHIP OF WASHINGTON, PENNSYLVANIA
WYOMING COUNTY



JULY 3, 1990

Federal Emergency Management Agency

COMMUNITY NUMBER - 422207

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

Part or all of this FIS may be revised and republished at any time. In addition, part of this FIS may be revised by the Letter of Map Revision (LOMR) process, which does not involve republication or redistribution of the FIS. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current FIS components.

Initial Flood Insurance Study Effective Date: July 3, 1990

Flood Insurance Study Revised:

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FLOOD INSURANCE STUDY
TOWNSHIP OF WASHINGTON, WYOMING COUNTY, PENNSYLVANIA

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Township of Washington, Wyoming County, Pennsylvania, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were prepared by the Baltimore District of the U. S. Army Corps of Engineers (COE) for the Federal Emergency Management Agency (FEMA), under Inter-Agency Agreement No. EMW-86-E-2226, Project Order No. 27. This work was completed in June 1988.

1.3 Coordination

On December 13, 1985, an initial Consultation and Coordination Officer's (CCO) meeting was held with representatives of FEMA, the COE (the study contractor), Wyoming County, and the township to determine the streams to be studied by detailed methods. During the preparation of the study, various Federal, state, and local agencies were contacted to obtain available mapping, survey data, flood history information, and other hydrologic data. Those contacted included the following: the Township of Washington, Wyoming County, the Pennsylvania Departments of Transportation and Environmental Resources, the U. S. Geological Survey (USGS), the Soil Conservation Service (SCS), and the Susquehanna River Basin Commission (SRBC).

On August 24, 1989, a final CCO meeting was held with representatives of FEMA, the study contractor, and the township to review the results of the study.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Township of Washington, Wyoming County, Pennsylvania. The area of study is shown on the Vicinity Map (Figure 1).

The Susquehanna River was studied by detailed methods for its entire length within the community. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction through June 1993.

West Branch Meshoppen Creek and Meshoppen Creek were studied by approximate methods. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and the Township of Washington.

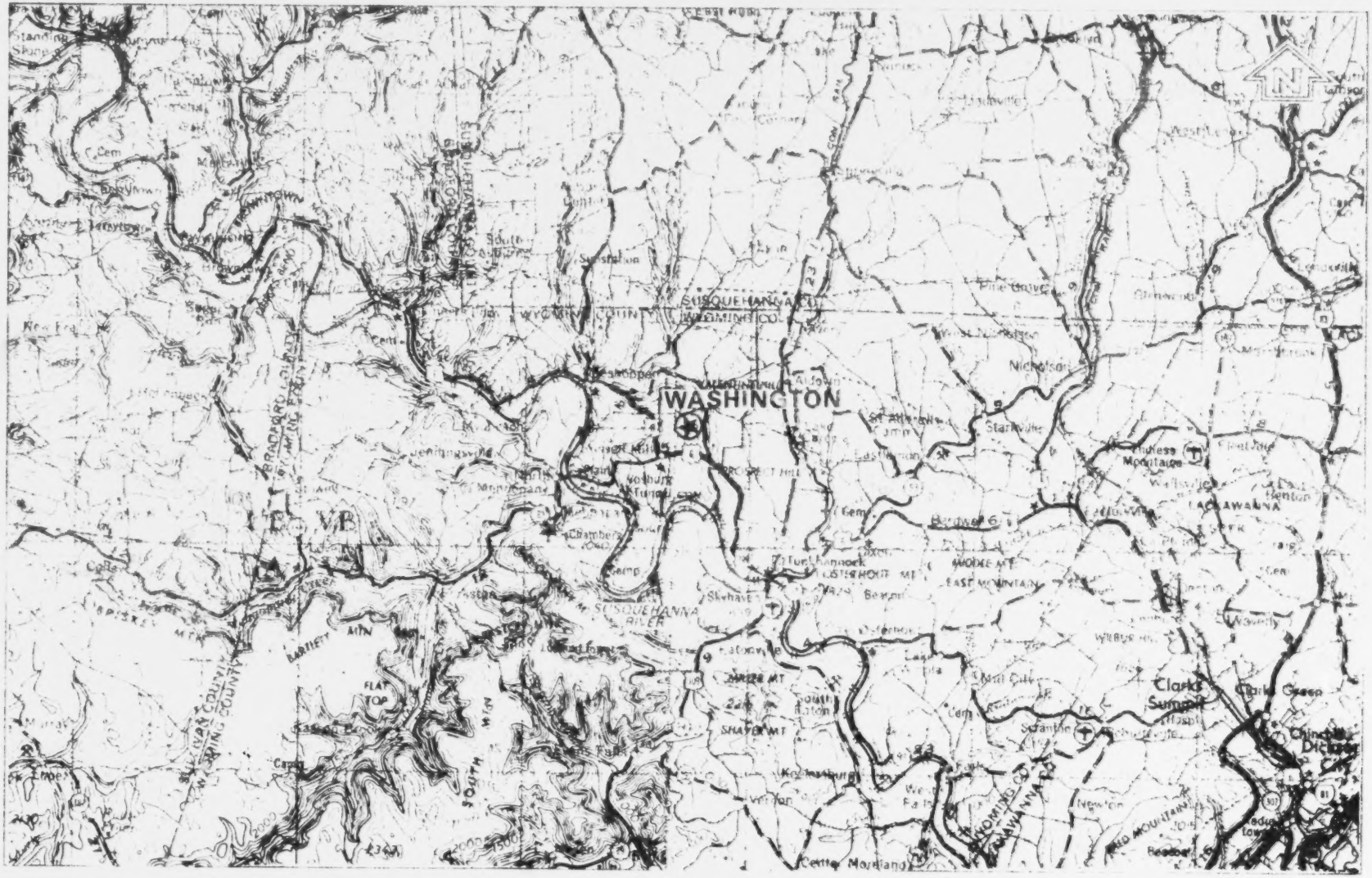
2.2 Community Description

The Township of Washington is located in the northern portion of Wyoming County, in northeast Pennsylvania, approximately 20 miles northeast of the City of Lock Haven. It is bordered by the Township of Lemon to the northeast, the Township of Tunkhannock to the southeast, the Township of Eaton to the south, the Township of Mehoopany to the southwest, the Township of Meshoppen to the northwest, and the Townships of Auburn and Springville to the north.

The Susquehanna River has a drainage area of approximately 8,913 square miles above the mouth of Tunkhannock Creek, downstream of the State Route 29 bridge.

2.3 Principal Flood Problems

The principal source of flooding within the Township of Washington is the Susquehanna River. There are no gages located on the Susquehanna River within the Township of Washington and no data are available to provide information about the magnitude and severity of past flooding in the area. There are two USGS gages located outside the township that have a long period of record (gage No. 01531500, located on the Susquehanna River near Towanda; and gage No. 01536500, located on the Susquehanna River near Wilkes-Barre). According to data from these gages, the flood of June 24, 1972 (Hurricane Agnes) is the flood of record for the area. No attempts have been made to determine the return frequency for the June 24, 1972 flood for this area.


WASHINGTON
SUSQUEHANNA
WYOMING CO.
Nicholson
Starrucca
Hudless Mountain
LACKAWANNA
Clarks Summit
Clarks Green
Chinchilla
Dickson City
Carbondale
Olyphant
Jermyn
Archbald
Mayfield
Jessup
Blakely
Peckville
Olyphant
Throop
Dunmore
Scranton
Moosic
Old Forge
Taylor
Duryea
Pittston
Avoca
Wyoming
Exeter
Kingston
Forty Fort
Wilkes-Barre
Plymouth
Nanticoke
Hanover
Newport
Shickshinny
Berwick
Bloomsburg
Danville
Milton
Lewisburg
Selinsgrove
Sunbury
Northumberland
Shamokin
Mount Carmel
Elysburg
Centralia
Mahanoy City
Ashland
Girardville
Shenandoah
Frackville
Tamaqua
Pottsville
Hazleton
Minersville
Schuylkill Haven
Port Carbon
Palo Alto
Tremont
Pine Grove
Lebanon
Annville
Cleona
Palmyra
Hershey
Harrisburg
Middletown
Mechanicsburg
Carlisle
Shippensburg
Chambersburg
Waynesboro
Gettysburg
Hanover
York
Lancaster
Ephrata
Lititz
Manheim
Mount Joy
Elizabethtown
Columbia
Marietta
Quarryville
Oxford
Kennett Square
West Chester
Coatesville
Downingtown
Phoenixville
Norristown
Conshohocken
Bryn Mawr
Ardmore
Haverford
Upper Darby
Lansdowne
Yeadon
Darby
Chester
Media
Swarthmore
Wallingford
Springfield
Aldan
Collingdale
Sharon Hill
Folcroft
Glenolden
Norwood
Prospect Park
Ridley Park
Eddystone
Crum Lynne
Trainer
Marcus Hook
Claymont
Wilmington
Newark
New Castle
Elsmere
Delaware City
Smyrna
Dover
Milford
Seaford
Laurel
Georgetown
Rehoboth Beach
Lewes
Bridgeville
Greenwood
Federalsburg
Denton
Easton
Cambridge
Hurlock
Salisbury
Fruitland
Princess Anne
Crisfield
Pocomoke City
Snow Hill
Berlin
Ocean City
Ocean Pines
Chincoteague
Wallops Island
Accomac
Onancock
Tangier
Parksley
Onley
Melfa
Exmore
Cheriton
Nassawadox
Eastville
Cape Charles
Kiptopeke
Virginia Beach
Norfolk
Portsmouth
Chesapeake
Suffolk
Franklin
Smithfield
Isle of Wight
Hampton
Newport News
Williamsburg
James City
York
Poquoson
Gloucester
Mathews
Middlesex
Urbanna
Tappahannock
Kilmarnock
Irvington
Lancaster
Warsaw
Montross
Colonial Beach
Oak Grove
Dahlgren
King George
Fredericksburg
Stafford
Quantico
Dumfries
Manassas
Manassas Park
Bristow
Gainesville
Haymarket
Warrenton
Culpeper
Orange
Madison
Charlottesville
Scottsville
Lovingston
Amherst
Lynchburg
Bedford
Forest
Appomattox
Farmville
Crewe
Blackstone
Hopewell
Petersburg
Colonial Heights
Chesterfield
Richmond
Henrico
Hanover
Ashland
Mechanicsville
Glen Allen
Short Pump
Tuckahoe
Goochland
Powhatan
Amelia
Nottoway
Dinwiddie
Prince George

2.4 Flood Protection Measures

There are no flood protection structures existing or planned within the Township of Washington.

3.0 ENGINEERING METHODS

For the flooding source studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. A flood event of a magnitude which is expected to be equaled or exceeded once on the average during any 100-year period (recurrence interval) has been selected as having special significance for floodplain management and for flood insurance rates. This event, commonly termed the 100-year flood, has a 1 percent chance of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for the flooding source studied in detail affecting the community.

Flood-frequency discharge values for the Susquehanna River were determined using statistical analyses performed for the USGS stream gages at Meshoppen and Wilkes-Barre. A two-station comparison was performed for the gage at Meshoppen in accordance with procedures outlined in USGS Bulletin 17B (Reference 1). This analysis extended the 10-year period of record at Meshoppen by correlating it with the 96 years of record at Wilkes-Barre. All flows were adjusted for the effect of upstream reservoirs. Discharges for ungaged points along the Susquehanna River were computed from the 100-year peak discharge at Meshoppen, using the ratio of the drainage areas to the 0.8 power. The 100-year discharge for the Susquehanna River at the downstream corporate limits of the Township of Washington was calculated to be 229,000 cubic feet per second (cfs). The 100-year flood discharge of 238,000 cfs presented in this study was taken from the Flood Insurance Studies for the Township of Meshoppen and the Boroughs of Meshoppen and Tunkhannock (References 2, 3, and 4).

A summary of the drainage area-peak discharge relationships for the stream studied by detailed methods is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGE (cfs) 100-YEAR
SUSQUEHANNA RIVER		
Above mouth of Tunkhannock Creek	8,913	238,000

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the source studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Cross sections used in the backwater analyses were obtained from the SRBC and included stream and floodplain cross sections, as well as structural geometry of all bridges, culverts, and other hydraulic structures. These data were developed by the SRBC in 1979 and 1981 during the preparation of Flood Insurance Studies for communities along the Susquehanna River in Wyoming County (References 2, 3, 4, 5, and 6).

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1) and the Flood Insurance Rate Map (Exhibit 2) where applicable.

Water-surface elevations of floods of the selected recurrence intervals were computed using the COE HEC-2 step-backwater computer program (Reference 7). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals. The starting water-surface elevation was provided by the SRBC. The results of the water-surface computations are tabulated for the selected cross sections for each stream segment (Table 2).

Channel roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and based on field reconnaissance of the stream and floodplain areas (References 8 and 9). The channel "n" values for the Susquehanna River ranged from 0.035 to 0.055, and the overbank "n" values ranged from 0.100 to 0.140.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps; the descriptions of the marks are presented in Elevation Reference Marks (Exhibit 3).

FLOODING SOURCE		STREAM CHANNEL			LEFT OVERBANK			RIGHT OVERBANK			100 YEAR FLOOD WATER SURFACE ELEVATION
CROSS SECTION	DISTANCE[1] (FT.)	WIDTH (FT.)	DISCHARGE (CFS)	MEAN VELOCITY (FT./SEC.)	WIDTH (FT.)	DISCHARGE (CFS)	MEAN VELOCITY (FT./SEC.)	WIDTH (FT.)	DISCHARGE (CFS)	MEAN VELOCITY (FT./SEC.)	
Susquehanna River											
A	1,200	672	234,982	8.48	0	0	0	356.95	3,018	1.20	615.28
B	2,300	661	235,303	8.56	51.90	7	0.33	379.60	2,690	1.10	616.06
C	3,310	796	236,199	8.22	0	0	0	434.81	1,801	0.75	616.62
D	4,170	914	236,335	7.49	0	0	0	451.01	1,665	0.71	617.07
E	5,850	919	236,573	7.62	109.05	16	0.31	322.39	1,411	0.74	617.54
F	7,810	834	235,612	7.98	201.19	1,766	1.12	39.91	622	1.22	618.08
G	8,310	770	236,286	8.14	223.00	1,606	1.08	16.62	108	0.99	618.24
H	9,040	745	234,569	8.09	328.80	3,300	1.20	14.16	132	1.01	618.61
I	10,500	710	233,389	8.29	412.70	4,497	1.23	14.13	114	0.99	619.27
J	12,210	730	234,958	8.50	373.52	2,885	0.94	17.82	156	0.93	619.89
K	13,800	735	234,515	8.79	442.90	3,437	1.00	8.96	48	0.70	620.38
L	15,950	840	236,202	8.58	223.34	1,599	1.18	21.81	200	1.26	621.47
M	17,240	775	235,570	8.77	288.41	2,191	1.28	21.41	239	1.37	622.31
N	18,820	796	235,056	8.21	339.75	2,994	1.13	0	0	0	623.32
O	20,580	733	235,575	8.82	355.98	2,425	1.17	0	0	0	624.11
P	22,080	550	228,058	8.94	596.55	9,863	1.59	9.22	79	0.91	625.00
Q	24,180	1,165	235,376	6.83	252.08	2,573	1.10	13.51	51	0.67	626.34
R	25,680	1,204	235,623	7.01	182.72	1,641	1.08	37.26	736	1.09	626.76
S	26,330	910	236,694	7.74	0	0	0	170.31	1,306	1.06	626.84
T	27,480	701	233,247	9.00	65.19	581	1.08	295.82	4,171	1.52	627.07
U	28,800	690	230,965	9.61	59.30	1,290	1.69	419.27	5,745	1.39	627.58
V	30,260	746	231,416	8.90	82.02	1,974	1.70	407.75	4,610	1.34	628.41
W	31,850	694	232,920	9.55	83.95	2,462	1.92	228.15	2,618	1.28	628.95
X	33,530	570	226,993	9.62	93.99	3,984	2.66	443.49	7,023	1.70	629.93
Y	36,630	1,381	235,034	6.22	180.32	2,867	1.40	51.37	100	8.53	632.08
Z	38,230	903	227,424	7.59	503.87	10,266	1.56	64.15	310	0.91	632.35

[1]Feet above corporate limits of Township of Tunkhannock

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF WASHINGTON, PA
(WYOMING CO.)

REGULATORY DATA

SUSQUEHANNA RIVER

FLOODING SOURCE		STREAM CHANNEL			LE
CROSS SECTION	DISTANCE[1] (FT.)	WIDTH (FT.)	DISCHARGE (CFS)	MEAN VELOCITY (FT./SEC.)	WIDTH (FT.)
Susquehanna River (continued)					
AA	39,080	879	233,773	7.83	447.1
AB	40,430	906	234,822	7.17	226.0
AC	42,230	1,252	237,904	5.89	94.1
AD	43,310	1,117	237,807	6.76	91.6
AE	44,040	1,176	237,974	6.09	32.6
AF	46,040	1,045	207,777	5.58	
AG	47,320	963	231,867	7.45	
AH	47,595	1,004	236,840	7.30	
AI	48,155	1,158	238,000	7.26	
AJ	48,390	1,185	238,000	7.22	
AK	49,290	1,090	236,990	6.74	
AL	50,790	1,021	236,049	6.98	
AM	52,340	1,003	234,091	7.81	
AN	54,270	1,041	231,769	7.57	

[1]Feet above corporate limits of Township of Tunkhannock

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF WASHINGTON, PA

(WYOMING CO.)

	LEFT OVERBANK			RIGHT OVERBANK			100 YEAR FLOOD WATER SURFACE ELEVATION
	WIDTH (FT.)	DISCHARGE (CFS)	MEAN VELOCITY (FT./SEC.)	WIDTH (FT.)	DISCHARGE (CFS)	MEAN VELOCITY (FT./SEC.)	
	447.16	4,227	1.37	13.01	0	0	632.59
	226.07	2,592	1.36	44.01	585	1.41	633.30
	94.14	91	0.34	5.55	5	0.33	633.80
	91.60	193	0.54	0	0	0	634.00
	32.60	26	0.34	0	0	0	634.10
	0	0	0	948.39	30,223	1.68	635.00
	0	0	0	489.68	6,130	1.11	635.00
	0	0	0	532.74	1,160	0.57	635.10
	0	0	0	0	0	0	635.45
	0	0	0	0	0	0	635.56
	0	0	0	134.13	1,010	0.88	635.88
	0	0	0	179.10	1,951	1.10	636.44
	0	0	0	431.08	3,909	1.14	636.93
	0	0	0	842.28	6,231	1.00	637.81

REGULATORY DATA

SUSQUEHANNA RIVER

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100-year floodplain boundaries to assist communities in developing floodplain management measures.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. For the stream studied in detail, the 100-year floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:24,000 with a contour interval of 20 feet (Reference 10).

For the flooding sources studied by approximate methods, the boundaries of 100-year floodplain were delineated using the Flood Hazard Boundary Map for the Township of Washington (Reference 11).

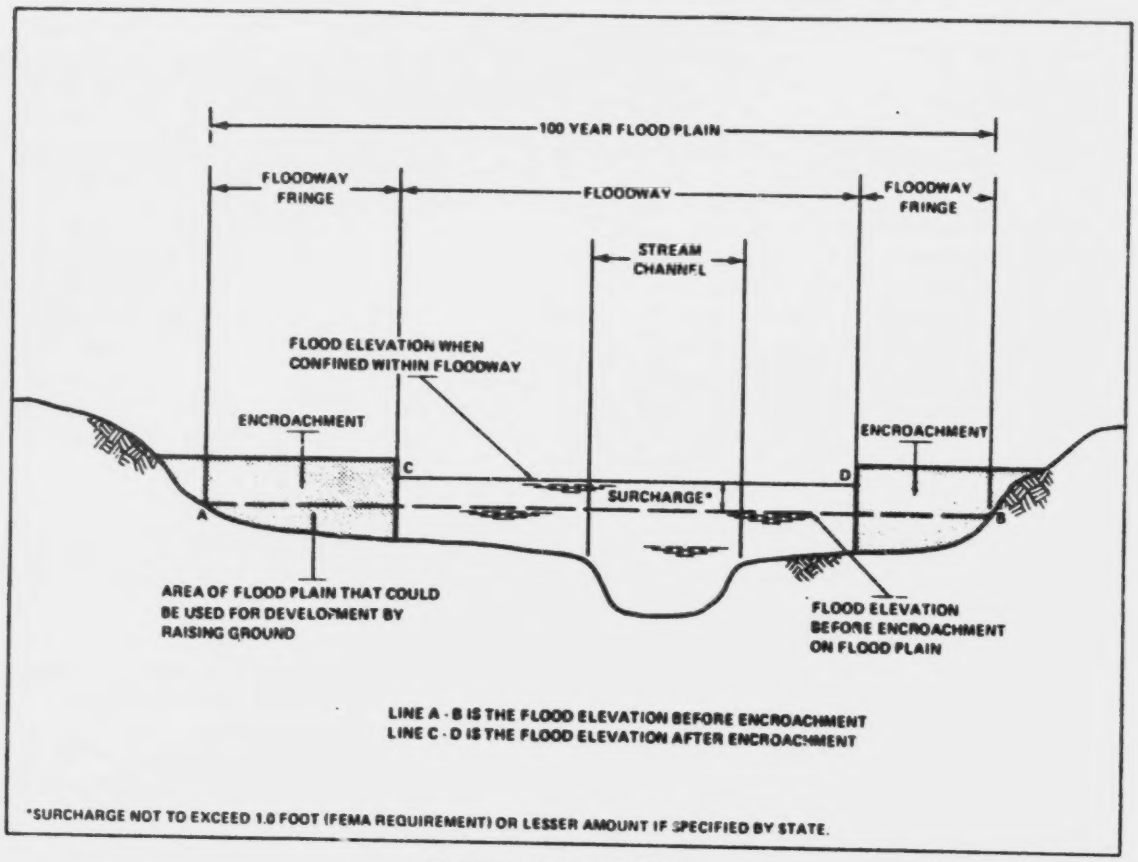
The 100-year floodplain boundaries are shown on the Flood Insurance Rate Map (Exhibit 2). On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AE). Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced.

The area between the floodway and 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed

without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 2.


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FLOODWAY SCHEMATIC Figure 2

No floodways were calculated as part of this study.

5.0 INSURANCE APPLICATIONS

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. The zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-depths derived from the detailed hydraulic analyses are shown within this zone.

Zone A99

Zone A99 is the flood insurance rate zone that corresponds to areas of the 100-year floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or depths are shown within this zone.

Zone V

Zone V is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no base flood elevations are shown within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year floodplain, areas within the 500-year floodplain, and to areas of 100-year flooding where average depths

Zone X (continued)

are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 100-year floodplain. The locations of selected cross sections used in the hydraulic analyses are shown where applicable.

7.0 OTHER STUDIES

Flood Insurance Studies have been prepared for the Townships of Eaton and Meshoppen and for the Borough of Meshoppen (References 5, 2, and 3). The results of this study are in exact agreement with the results of those studies.

Due to its more detailed nature, this study supersedes the Flood Hazard Boundary Map for the Township of Washington (Reference 11).

8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting FEMA, the Natural and Technological Hazards Division, Liberty Square Building (Second Floor), 105 South Seventh Street, Philadelphia, Pennsylvania 19106.

9.0 BIBLIOGRAPHY AND REFERENCES

1. U. S. Department of the Interior, Geological Survey, Office of Water Data Collection, Interagency Advisory Committee on Water Data, "Guidelines for Determining Flood Flow Frequency," Bulletin 17B, Reston, Virginia, Revised September 1981.

2. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, Township of Meshoppen, Wyoming County, Pennsylvania, Washington, D. C., February 15, 1980.

3. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, Borough of Meshoppen, Wyoming County, Pennsylvania, Washington, D. C., September 16, 1981.

4. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, Borough of Tunkhannock, Wyoming County, Pennsylvania, Washington, D. C., December 18, 1979.

5. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, Township of Eaton, Wyoming County, Pennsylvania, Washington, D. C., May 1, 1980.

6. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, Township of Exeter, Wyoming County, Pennsylvania, Washington, D. C., February 1, 1980.

7. U. S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water Surface Profiles, Generalized Computer Program, Davis, California, September 1982.

8. Ven Te Chow, Open-Channel Hydraulics, New York, McGraw-Hill, 1959.

9. U. S. Department of the Interior, Geological Survey, Water-Supply Paper 1849, Roughness Characteristics of Natural Channels by Harry H. Barnes, Jr., Washington, D. C. 1967.

10. U. S. Department of the Interior, Geological Survey, 7.5-Minute Series Topographic Maps, Scale 1:24,000, Contour Interval 20 Feet:

11. U. S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, Township of Washington, Wyoming County, Pennsylvania, December 6, 1974.

EXHIBIT 3 - ELEVATION REFERENCE MARKS

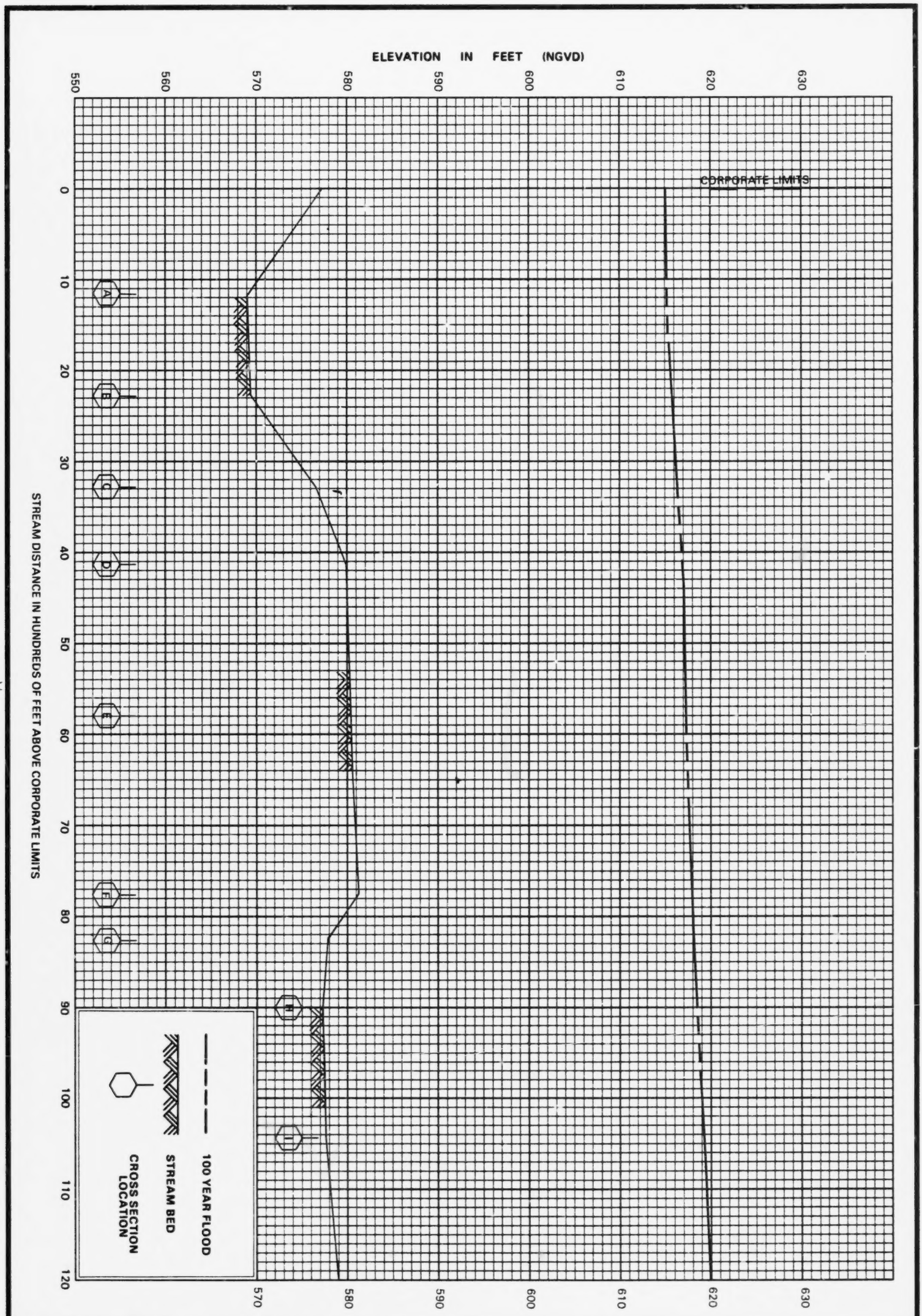
Reference Mark	FIRM Panel	Elevation (Feet NGVD)	Description of Location
RM 1	10	622.57	USGS bench mark, stamped H58 Reset 1966, on CONRAIL bridge over small creek, on east side of Vosberg Tunnel.
RM 2	10	620.88	Northwest corner of concrete step on north side of 2-car garage (outboard repair shop - Schaffer's Campground), approximately 25 feet east of centerline of Township Route 506 (Vosberg Road), approximately 3 feet north of northwest corner of garage, and approximately 74 feet east of southeast corner of private dwelling.
RM 3	10	635.01	X cut in southeast corner of abandoned foundation, approximately 46 feet west of centerline of Township Route 506 (Vosberg Road), approximately 100 feet west of utility pole No. 12W6, approximately 191 feet northwest of northwest corner of 2-story wood frame barn on east side of Township Route 506 (Vosberg Road).
RM 4	10	633.09	Southwest corner of ground concrete step of private dwelling, a 2.5-story house, approximately 82 feet east of centerline of Township Route 506 (Vosberg Road), approximately 13 feet southwest of northwest corner of house, and approximately 98 feet east of utility pole No. 12W11.
RM 5	10	653.30	Southwest corner of Polly Maxwell's tombstone, approximately 114 feet west of centerline of Township Route 506 (Vosberg Road), approximately 23.5 feet southeast of southeast corner of William Jayne's grave, and approximately 6.5 feet southwest of southwest corner of Robert Calvert's grave.

EXHIBIT 3 - ELEVATION REFERENCE MARKS - continued

Reference Mark	FIRM Panel	Elevation (Feet NGVD)	Description of Location
RM 6	10	623.26	X cut in southeast corner (just north of southeast corner pole) of concrete base of small pavilion in Camp Lackawanna, approximately 273 feet south of centerline of Camp Lackawanna Road, approximately 600 feet north of the Susquehanna River, approximately 342 feet southeast of southeast corner of 1-story wood cabin, and approximately 55 feet north of dirt road.
RM 7	10	627.84	Square cut in northeast corner of concrete light base, approximately 14 feet south of centerline of south CONRAIL tracks, and approximately 164 feet west of west end of Vosberg Tunnel.
RM 8	10	627.26	X cut in northeast corner of concrete light base, approximately 9 feet south of centerline of south CONRAIL tracks, and approximately 40 feet north of edge of the Susquehanna River.
RM 9	10	635.95	Northeast corner of Samuel J. Rogers' tombstone, approximately 141 feet north of centerline of north CONRAIL tracks, approximately 140 feet east of centerline of small creek, and approximately 20 feet northeast of southeast corner of Truman Russell's grave.
RM 10	10	637.24	X cut on top of manhole/vent, approximately 31 feet south of south CONRAIL tracks, approximately 436 feet northeast of northwest corner of 1-story woodframe warehouse on cinderblock foundation.
RM 11	10	632.73	Northeast corner of bottom concrete step with railing of private dwelling approximately 37 feet south of centerline of CONRAIL tracks, approximately 40 feet northwest of northeast corner of house, and approximately 44.5 feet east of utility pole No. 12W189.

EXHIBIT 3 - ELEVATION REFERENCE MARKS - continued

Reference Mark	FIRM Panel	Elevation (Feet NGVD)	Description of Location
RM 12	10	640.31	USGS bench mark on abandoned bridge abutment over the Susquehanna River near Mehoopany Station.
RM 13	10	637.43	X cut in east side of concrete base of light pole, approximately 10 feet east of east CONRAIL tracks, approximately 5 feet west of utility pole, and approximately 100 feet east of the Susquehanna River.
RM 14	10	637.72	X cut in west side of concrete base of light pole, approximately 100 feet east of the Susquehanna River, approximately 12 feet west of CONRAIL tracks, and approximately 50 feet west of cliff.



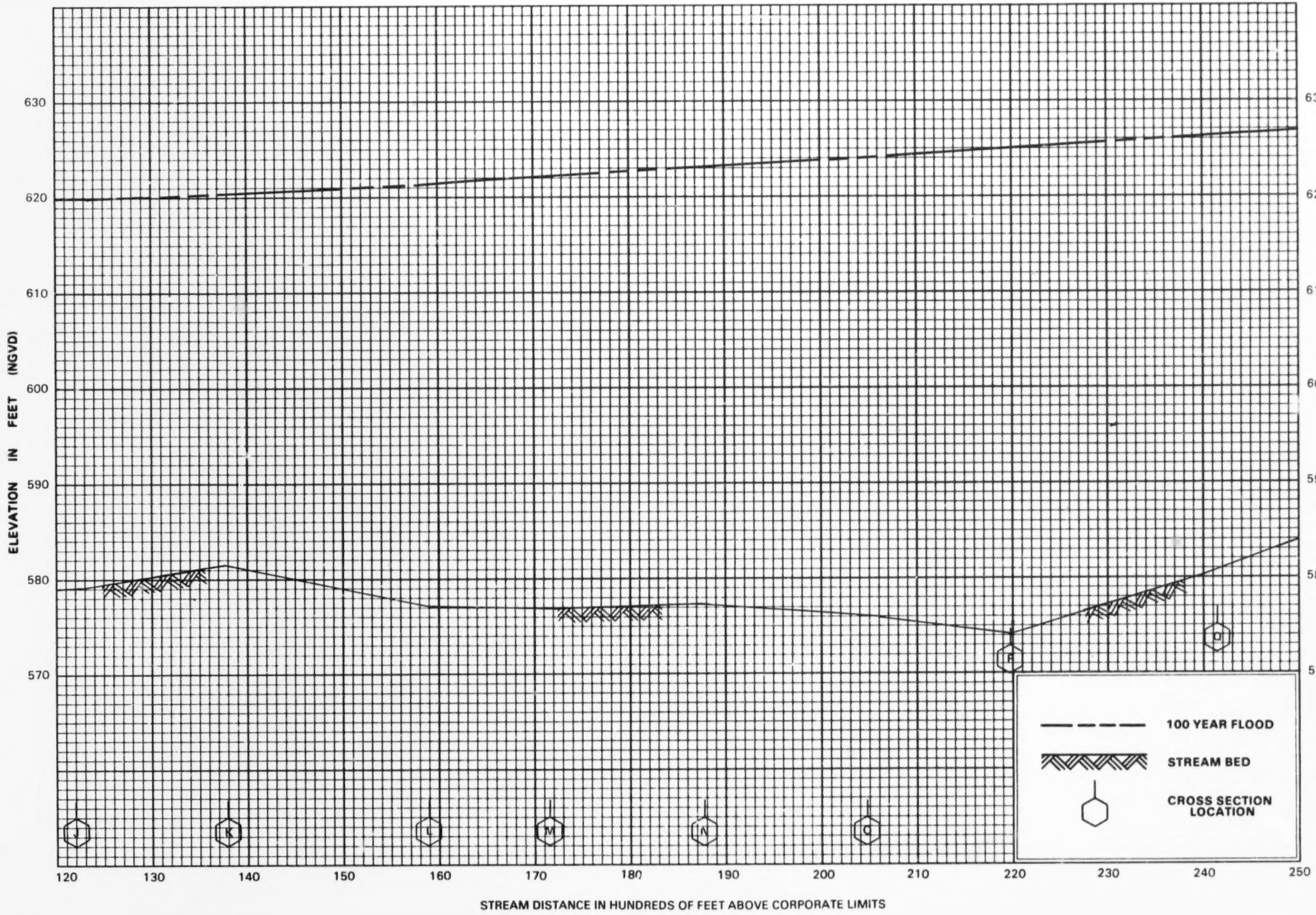
FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF WASHINGTON, PA
(WYOMING CO.)

FLOOD PROFILES

SUSQUEHANNA RIVER

01P



FLOOD PROFILES

SUSQUEHANNA RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

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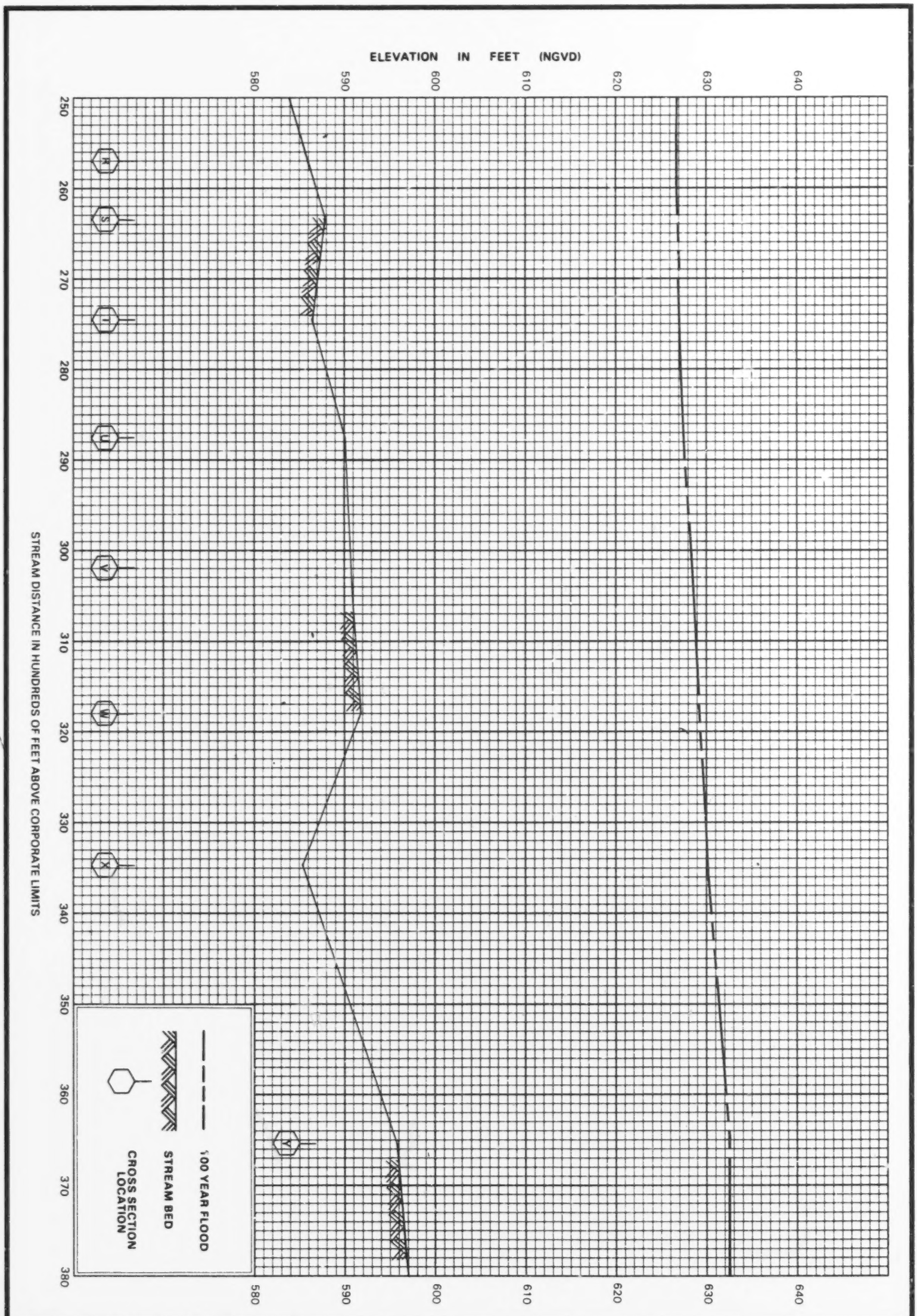
(WYOMING CO.)

02P



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FEDERAL EMERGENCY MANAGEMENT AGENCY

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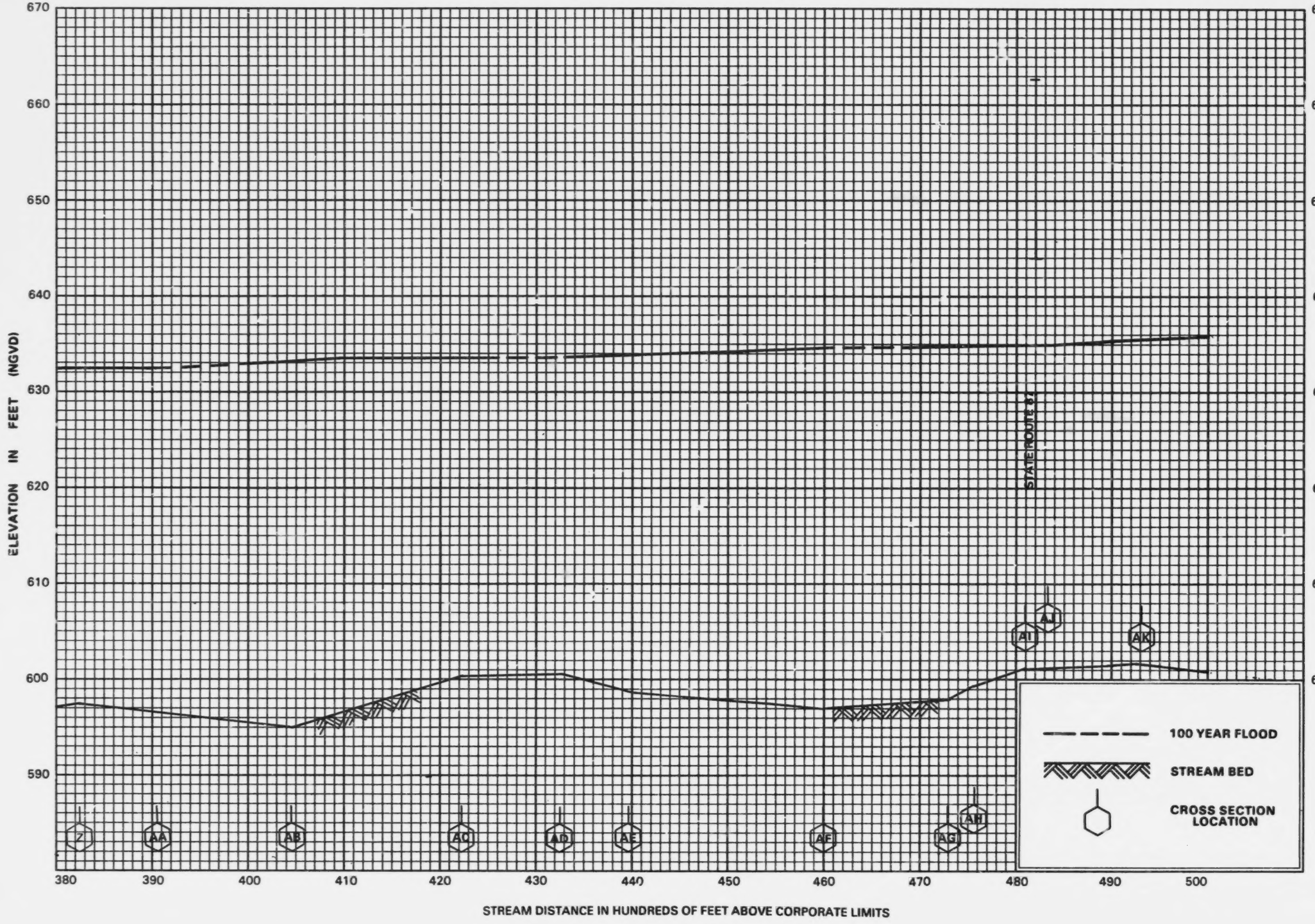
(WYOMING CO.)

FLOOD PROFILES

SUSQUEHANNA RIVER



FLOOD PROFILES

SUSQUEHANNA RIVER

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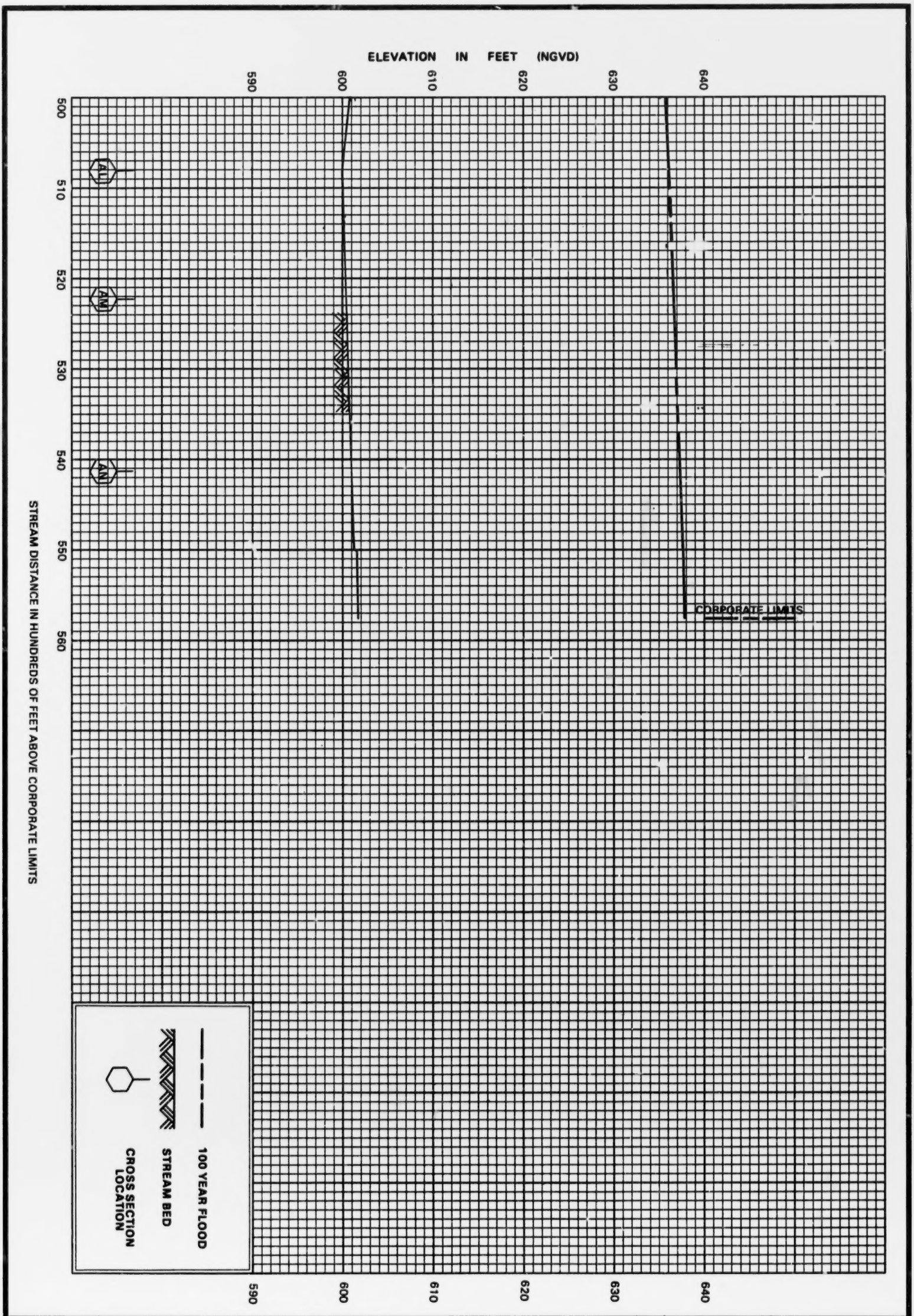
04P



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FLOOD PROFILES

SUSQUEHANNA RIVER